

Web-based air conditioner controller

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ABSTRACT

Humans often forget to turn off the Air Conditioner (AC) where he works. Forgetting to turn off the air conditioner causes the company to lose in saving electricity. This paper contributes to the design of an air conditioning control system and room temperature monitoring using website media. This system can be controlled and monitored remotely. In turning on / off the air conditioner and monitoring the temperature in the room, usually someone cannot do these activities because they are doing other activities that cannot be left behind. This system designed uses Arduino Mega which is connected to the ESP8266-01 module for Wi-fi connection and DS18B20 to monitor room temperature. In addition, the TCS3200 sensor is also used to determine the condition of the AC indicator LED. Display data is served via a local IP web server. Based on the test results, it was found that this device is able to work optimally to turn off and turn on the air conditioner without having to go to the room.

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1. INTRODUCTION

The development of technology at this time is very fast, technology and information have become a necessity among the people. One example of the rapid development of technology and information is the website. The website is an information page provided via the internet or local internet networks, so that it can be accessed by all computer or mobile devices, provided that all devices are connected to each other or in one network, with wi-fi media or network cables. The website can also be used for controlling electronic devices, for example to turn on/off the air conditioner and also to monitor the state of the room temperature.

Web technology is a technology used for remote monitoring and control of electronic equipment that has been widely studied by previous researchers. Sunlight Intensity Measurement System with Solar Tracking System can be posted on the web server researched by Putra [1]. The study of proper mushroom cultivation based on feedback perception was investigated by Hongpo [2]. The realization of IoT-based fish pond control using a mobile application was researched by Kim [3].

Field Agronomic Condition Test (F.A.C.T.) Environmental Sensing: The Future of Agriculture and IOT Conservation researched by Krause [4]. IoT Wi-Fi Sensor Connected For Real Time Heart Rate Variability Monitoring researched by Rajanna [5].

Other researchers have researched monitoring technology with the web. Natural language processing for web browsing analysis: Challenges, lessons and opportunities researched by Perdices [6]. Citizen science provides added value in monitoring non-indigenous coastal species studied by Lehtiniemi [7]. Web-Based Platform for Data Analysis and Monitoring researched by Reiff [8]. Determination of Access Levels for the Exchange of Health Sensitive Data through the Semantic Web was investigated by Lima [9]. The

development and testing of a platform aimed at comprehensive monitoring of the indoor environment and building energy was investigated by Scarpa [10].

Environmentally friendly and organic management practices allow diversification of the complementary plant-bee food web studied by Marja [11]. About the performance of web services, Google cloud messaging and firebase cloud messaging were researched by Albertengo [12]. Effects of two web-based interventions promoting physical activity among older adults compared with a delayed intervention control group in Northwest Germany: Results of the PROMOTE community-based intervention trial studied by Muellmann [13]. Designing an intuitive web application for drug discovery scientists was researched by Karamanis [14]. Transformer Fleet Monitoring researched by Jaković [15]

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Design and Implementation of Dashboard Web Based Video Surveillance in OpenStack Swift researched by Siagian [26]. Species-specific biomagnification and habitat-dependent trophic transfer of halogenated organic pollutants in insect-dominated food webs from e-waste recycling sites were investigated by Liu [27]. Web-based self-help with and without chat counseling to reduce cocaine use in cocaine abusers: Results of a three-arm randomized controlled trial studied by Schaub [28]. Steps Towards Progressive Web Development in Midwifery researched by Loreto [29]. Wireless data management system for environmental monitoring in farm buildings researched by Gray [30]

By using the website, all these things can be done remotely. This paper contributes to making a system that uses Arduino Mega which is connected to the ESP8266-01 module for Wi-fi connection and DS18B20 to monitor room temperature. On the basis of these problems, made a tool that can turn on /turn off the Air Conditioner (AC) and monitor the room temperature using the website. In this way an activity that cannot be left undisturbed and we can monitor the state of the room.

2. METHODS

The tool was designed in several blocks describing general description of the work system shown in figure 1. The block diagram consists of several components with different functions. Input, process and output are parts of the diagram. The input is DS18B20 temperature and humidity sensor which serves to detect and read the temperature of the room and the ESP8266 Wi-fi Module to connect to the network so that it can be accessed by other devices. The TCS3200 serves to detect program conditions according to the color of the lights in the AC. The IR Transmitter serves to send a signal that has been programmed on Arduino. Furthermore, the data will be processed by the Arduino as the controller center.

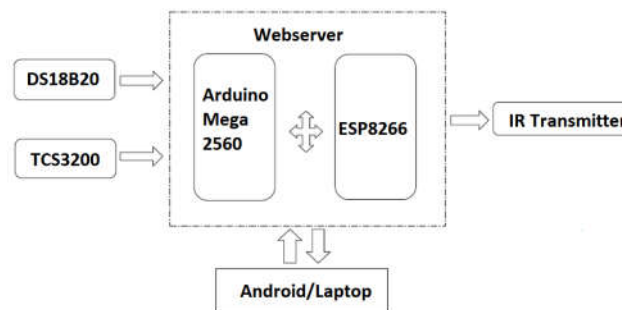


Fig. 1. Block diagram of the system

2.1. Hardware design

An arduino Mega board is a microcontroller board with an Atmega2560 microcontroller, an IC component, and a serial to USB as shown in figure 2. There is a port or pin widely used for input and output of the ESP8266 sensors and wi-fi. The port input and output are shown in Table 1. The table presents that the DS18B20 sensor is connected to the PIN 3 Arduino Mega ATMEGA2560, Sensor TCS3200 is connected to PIN 4, PIN 5, PIN 6, PIN 7, and PIN 8 Arduino Mega ATMEGA2560, ESP8266-01 Wi-Fi is connected to PIN 18 (Tx) and PIN 19 (Rx) Arduino Mega ATMEGA2560, and the IR Transmitter is connected to the PIN 9 Arduino Mega ATMEGA2560.

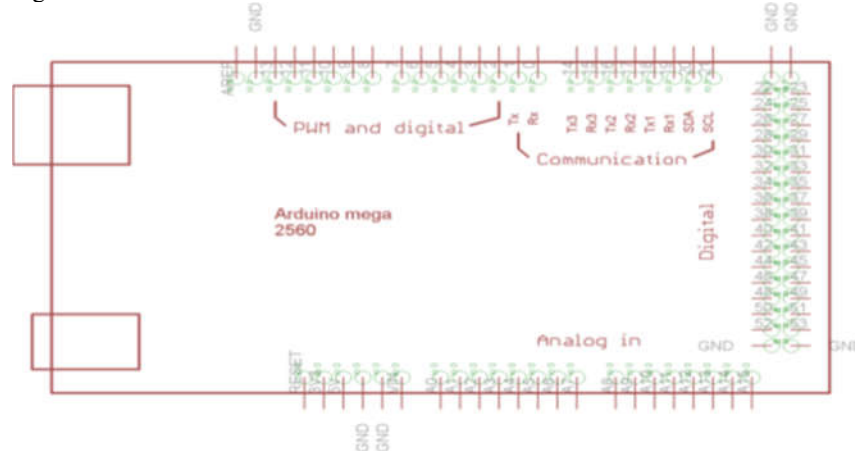


Fig. 2. Arduino Mega 2560 Pinout

In the infrared receiver design, the infrared receiver is used to decode the remote AC infrared signal into a decimal number. Things that need to be considered when decoding are taking infrared remote code in a closed place so that all signals can enter and decode on the infrared receiver. The color reading system uses the TCS3200 Sensor. The output of this sensor is digital. These frequency data become a color reference that will be used as a color detector on the AC LED indicator. The temperature reading system uses a DS18B20 sensor. When the DS18B20 sensor obtains temperature data the DS18B20 sensor calibrates simultaneously. The temperature data sent by the DS18B20 sensor is in the form of decimal data

Table 1. Distribution of ports on Arduino Mega 2560

No	Name	Pin used	Remark
1	Sensor DS18B20	PIN 3	Input
2	Sensor TCS3200	PIN 4	Input
3		PIN 5	Input
4		PIN 6	Input
5		PIN 7	Input
6		PIN 8	Input
7	Wi-Fi ESP8266-01	PIN 18 (Tx)	Input
8		PIN 19 (Rx)	Input
9	IR Transmitter	PIN 9	Input

2.2. Software design

The main flowchart of data transmission in the web-based AC control system is shown in figure 3. The figure illustrates that the flow diagram begins with initializing the call register of the microcontroller ports used for the operation of the tool. First connecting the ESP8266 to the Wi-Fi network, and then programming the ESP8266-01 tool to get an IP address used as a web server. And finally programming the DS18B20 and TCS3200 sensors so that the sensors can be read. The data are sent to the web server to be displayed on the web page.

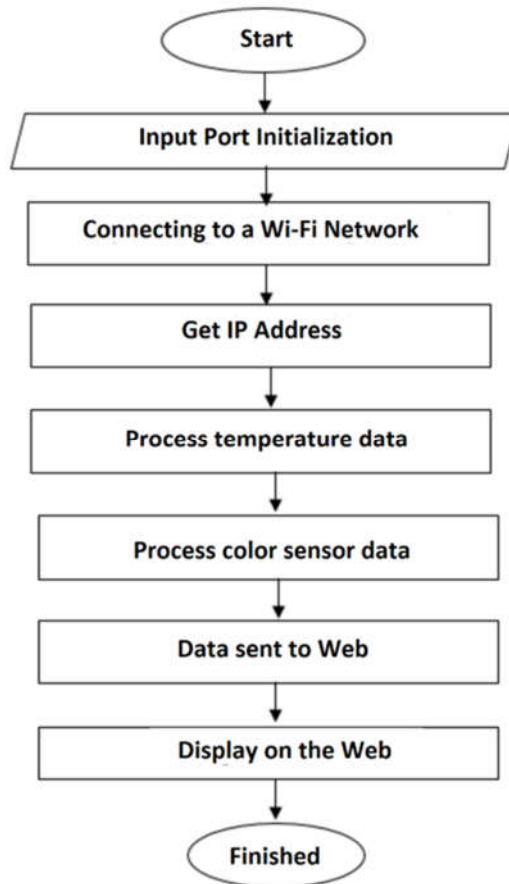


Fig. 3. Workflow diagram of the program

2.3. Interface design

User Interface in performing the display design is HTML as the basic web programming language as shown in Figure 4. There are four buttons for controlling the AC namely the ON button, COOL button, OFF button and DRY button. The temperatures displays in degrees Celsius and in degrees Fahrenheit.

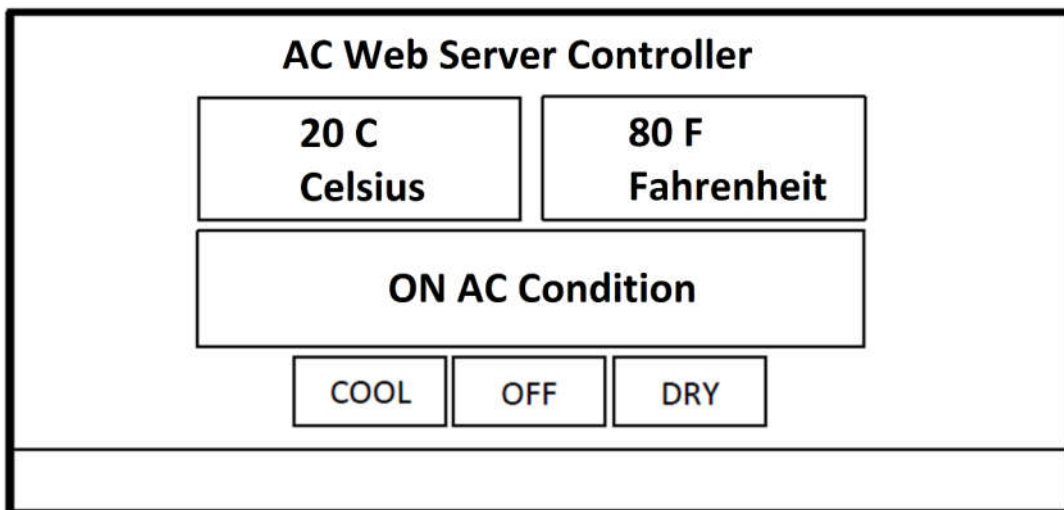


Fig. 4. Program interface diagram

3. RESULTS AND DISCUSSION

This section contains the results and discussion of the AC controller system using ESP8266 as the web server, which consists of the results of designing and the results of testing on each temperature, infrared, color sensor, and ESP8266-01 module with Arduino Mega 2560. The test results are the data obtained to show whether the designed hardware and software work properly or not. Based on the data, the overall performance of the device was analyzed to get better and more accurate results to draw final conclusions on the device.

3.1. Results of hardware design

The results of the hardware design are shown in Figure 5. The image consists of Arduino Mega 2560, ESP8266-01 module, temperature sensor, color sensor as input and infrared as output. The results of the hardware circuit are used for controller and monitoring systems.



Fig. 5. Web-based AC controller tool

3.2. Calibrate the temperature sensor

The temperature sensor circuit uses Arduino Mega 2560 as the input to run programs on the Arduino IDE. The temperature measurement results with DS18B20 were compared to the thermometer and the comparison results are displayed in figure 5. The graphs shows that the error occurs is not too large indicating that the sensor can work properly. The sensor is said to work well if the temperature sensor comparison with the thermometer is not too far away.

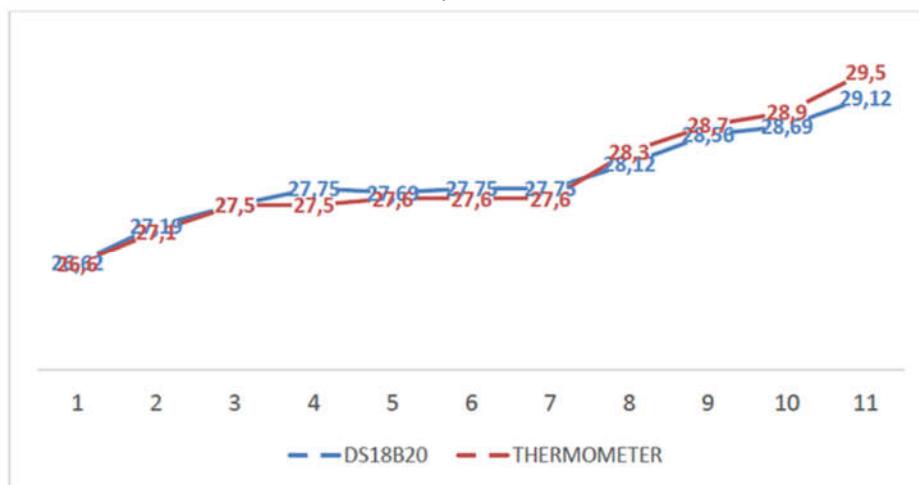


Fig. 6. Graph of DS18B20 sensor and thermometer readings

3.3. Color sensor calibration

Sampling was taken 10x when the AC indicator LED was on and when the AC indicator LED was off, as shown in figure 6. The sampling was done to get the right frequency value and minimize the error in determining the LED indicator ON or OFF. In this case, the required color sampling was green which indicated the indicator of the power LED on the AC. Based on the results of sampling and testing with an oscilloscope, the data showed that TCS3200 had a square wave frequency. When the TCS3200 was exposed to LED light, the frequency changed. In this study when the AC LED was off, the TCS3200 converted white color on AC chassis. It can be concluded, based on the data, that when the frequency is less than 2924, the AC is ON, but when the frequency is more than or equal to 2924 the AC is OFF.

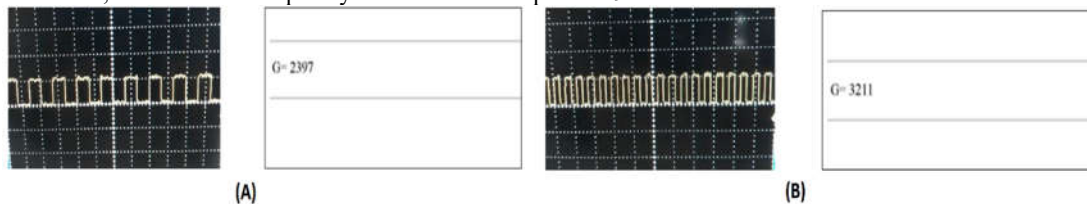


Fig. 7. (a) The conversion results of TCS3200 in LED ON condition and (b) in LED OFF condition

3.4. Infrared testing

In this study the infrared receiver used was the TSOP 4838 type with a 5V input voltage as shown in Figure 8. The figure shows that to get accurate remote decode data, the thing to note is that the condition of the room is far from infrared frequency noise and remote frequency transmission is carried out in a tightly closed place so that all incoming frequencies are on the infrared receiver. The result of decoding the remote AC showed that the decode result cannot be used to send a signal using the infrared transmitter. The thing to do is to convert negative values to positive values.

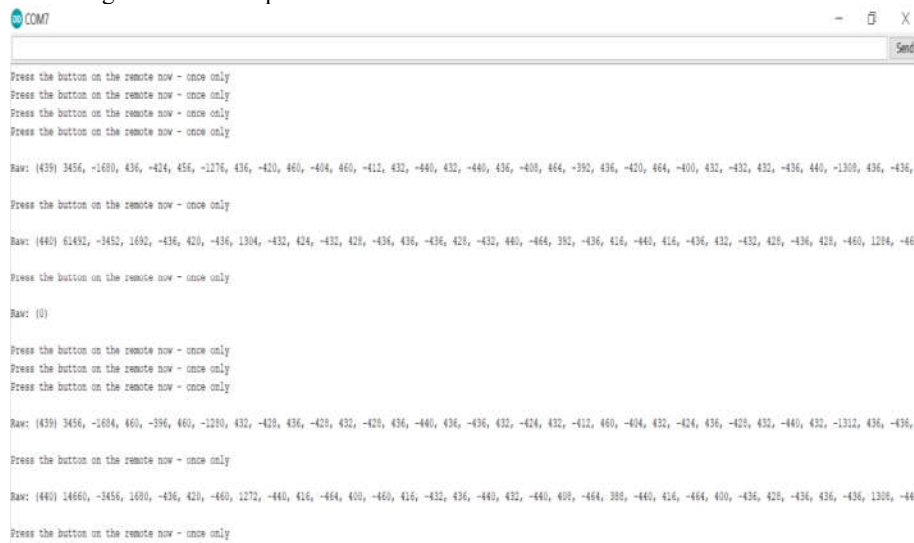


Fig. 8. The result of decoding the AC remote

3.5. Web server interface

The process of making this web server interface uses HTML (Hypert Text Markup Language) where the HTML coding process is designed on a web server and directly entered into the Arduino through the Arduino IDE program shown in Figure 8. It can be seen that the background display of the web is black and the buttons are blue.

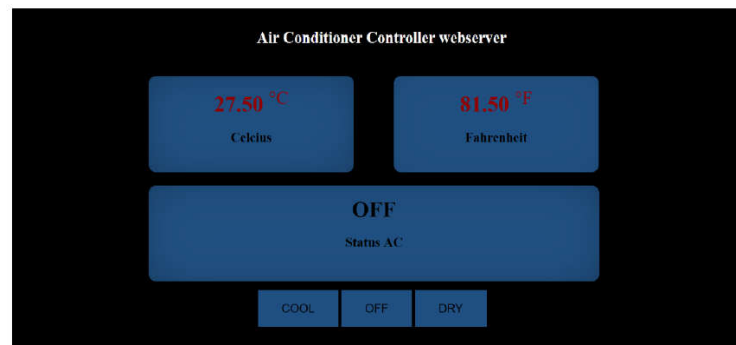


Fig. 9. The overall display results of the sensor in a web browser

4. CONCLUSION

It was found that the performance of each hardware and software is exquisite. The DS18B20 sensor can detect room temperature with an average error of 0.04%, and the TCS3200 sensor can convert the color on the AC LED indicator. The frequency is used to determine whether the AC is ON or OFF displayed on the web server and whether the Infrared LED working to turn off and activate AC is in COOL or DRY condition. The ESP8266 module works properly when sending and receiving the data from the sensors to the web server. It takes about 10 seconds to display the entire data in the web server.

DECLARATION

Author Contribution

The tool was designed in several blocks describing general description of the work system.

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Conflict of Interest

Declare conflicts of interest or state “The authors declare no conflict of interest.”

REFERENCES

- [1] I. G. E. W. Putra, I. K. P. Suniantara, and I. N. S. Kumara, “Sunlight Intensity Measurement System with Solar Tracking System,” in 2018 2nd International Conference on Applied Electromagnetic Technology (AEMT), 2018, pp. 12–15.
- [2] W. Hongpo and Z. Hong, “Study on precise mushroom cultivation based on feedback perception,” in 2018 IEEE 3rd International Conference on Cloud Computing and Big Data Analysis (ICCCBDA), 2018, pp. 506–510.
- [3] Y. Kim, N. Lee, B. Kim, and K. Shin, “Realization of IoT Based Fish Farm Control Using Mobile App,” in 2018 International Symposium on Computer, Consumer and Control (IS3C), 2018, pp. 189–192.
- [4] W. Krause, A. Jarrett, J. Bertish, and C. Jaiswal, “Field Agronomic Condition Test (F.A.C.T.) Environmental sensing: The Future of Agricultural and Conservation IOT,” in 2018 9th IEEE Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON), 2018, pp. 196–202.
- [5] R. R. Rajanna, S. Natarajan, and P. R. Vittal, “An IoT Wi-Fi Connected Sensor For Real Time Heart Rate Variability Monitoring,” in 2018 3rd International Conference on Circuits, Control, Communication and Computing (I4C), 2018, pp. 1–4.
- [6] D. Perdices, J. Ramos, J. L. García-Dorado, I. González, and J. E. López de Vergara, “Natural language processing for web browsing analytics: Challenges, lessons learned, and opportunities,” *Comput. Networks*, vol. 198, p. 108357, Oct. 2021.
- [7] M. Lehtiniemi, O. Outinen, and R. Puntilla-Dodd, “Citizen science provides added value in the monitoring for coastal non-indigenous species,” *J. Environ. Manage.*, vol. 267, p. 110608, Aug. 2020.
- [8] C. Reiff, S. Oechsle, F. Eger, and A. Verl, “Web-based Platform for Data Analysis and Monitoring,” *Procedia CIRP*, vol. 86, pp. 31–36, 2019.

- [9] V. C. Lima, D. Alves, F. C. Pellison, V. T. Yoshiura, N. Y. Crepaldi, and R. P. Chartes Lopes Rijo, "Establishment of Access Levels for Health Sensitive Data Exchange through Semantic Web," *Procedia Comput. Sci.*, vol. 138, pp. 191–196, 2018.
- [10] M. Scarpa, R. Ravagnin, L. Schibuola, and C. Tambani, "Development and testing of a platform aimed at pervasive monitoring of indoor environment and building energy," *Energy Procedia*, vol. 126, pp. 282–288, Sep. 2017.
- [11] R. Marja, A.-M. Klein, E. Viik, and P. Batáry, "Environmentally-friendly and organic management practices enable complementary diversification of plant–bumblebee food webs," *Basic Appl. Ecol.*, vol. 53, pp. 164–174, Jun. 2021.
- [12] G. Albertengo, F. G. Debele, W. Hassan, and D. Stramandino, "On the performance of web services, google cloud messaging and firebase cloud messaging," *Digit. Commun. Networks*, vol. 6, no. 1, pp. 31–37, Feb. 2020.
- [13] S. Muellmann et al., "Effects of two web-based interventions promoting physical activity among older adults compared to a delayed intervention control group in Northwestern Germany: Results of the PROMOTE community-based intervention trial," *Prev. Med. Reports*, vol. 15, no. July, p. 100958, Sep. 2019.
- [14] N. Karamanis, M. Pignatelli, D. Carvalho-Silva, F. Rowland, J. A. Cham, and I. Dunham, "Designing an intuitive web application for drug discovery scientists," *Drug Discov. Today*, vol. 23, no. 6, pp. 1169–1174, Jun. 2018.
- [15] T. Jaković, I. Murat, F. Klarić, and S. Keitoue, "Transformer Fleet Monitoring," *Procedia Eng.*, vol. 202, pp. 20–28, 2017.
- [16] F. De Simone et al., "The GOS4M Knowledge Hub: A web-based effectiveness evaluation platform in support of the Minamata Convention on Mercury," *Environ. Sci. Policy*, vol. 124, no. June, pp. 235–246, Oct. 2021.
- [17] S. Comero et al., "A conceptual data quality framework for IPCHEM – The European Commission Information Platform for chemical monitoring," *TrAC Trends Anal. Chem.*, vol. 127, p. 115879, Jun. 2020.
- [18] B. Drury, R. Fernandes, M. Moura, and A. de Andrade Lopes, "A survey of semantic web technology for agriculture," *Inf. Process. Agric.*, vol. 6, no. 4, pp. 487–501, Dec. 2019.
- [19] C. Wu, A. Alaoui-Soce, and J. M. Wolfe, "Event monitoring: Can we detect more than one event at a time?," *Vision Res.*, vol. 145, no. September 2017, pp. 49–55, Apr. 2018.
- [20] V. S. Arumuga Perumal, K. Baskaran, and S. K. Rai, "IMPLEMENTATION OF EFFECTIVE AND LOW-COST BUILDING MONITORING SYSTEM(BMS) USING RASPBERRY PI," *Energy Procedia*, vol. 143, pp. 179–185, Dec. 2017.
- [21] S. Kirrane, "Intelligent software web agents: A gap analysis," *J. Web Semant.*, vol. 71, p. 100659, Nov. 2021.
- [22] Y. Ding et al., "Bioaccumulation and trophic transfer of organophosphate esters in tropical marine food web, South China Sea," *Environ. Int.*, vol. 143, no. July, p. 105919, Oct. 2020.
- [23] B. Jonas, M. Tensil, F. Leuschner, E. Strüber, and P. Tossmann, "Predictors of treatment response in a web-based intervention for cannabis users," *Internet Interv.*, vol. 18, no. July, p. 100261, Dec. 2019.
- [24] S. Selvakumaran, S. Plank, C. Geiß, C. Rossi, and C. Middleton, "Remote monitoring to predict bridge scour failure using Interferometric Synthetic Aperture Radar (InSAR) stacking techniques," *Int. J. Appl. Earth Obs. Geoinf.*, vol. 73, no. June, pp. 463–470, Dec. 2018.
- [25] E. Siroombo, M. Filippi, A. Catalano, and A. Sica, "Building monitoring system in a large social housing intervention in Northern Italy," *Energy Procedia*, vol. 140, pp. 386–397, Dec. 2017.
- [26] P. Siagian and E. Fernando, "The Design and Implementation of a Dashboard Web-Based Video Surveillance in OpenStack Swift," *Procedia Comput. Sci.*, vol. 179, no. 2020, pp. 448–457, 2021.
- [27] Y. Liu et al., "Species-specific biomagnification and habitat-dependent trophic transfer of halogenated organic pollutants in insect-dominated food webs from an e-waste recycling site," *Environ. Int.*, vol. 138, no. March, p. 105674, May 2020.
- [28] M. P. Schaub et al., "Web-based self-help with and without chat counseling to reduce cocaine use in cocaine misusers: Results of a three-arm randomized controlled trial," *Internet Interv.*, vol. 17, no. May, p. 100251, Sep. 2019.
- [29] P. Loreto, J. Braga, H. Peixoto, J. Machado, and A. Abelha, "Step Towards Progressive Web Development in Obstetrics," *Procedia Comput. Sci.*, vol. 141, pp. 525–530, 2018.
- [30] J. Gray, T. M. Banhazi, and A. A. Kist, "Wireless data management system for environmental monitoring in livestock buildings," *Inf. Process. Agric.*, vol. 4, no. 1, pp. 1–17, Mar. 2017.